THE STANDARDIZATION OF WORKING ESSENTIALS

By Lillian Erskine,

Investigator of Occupational Disease, New Jersey Department of Labor,

In collaboration with

John Roach,

Chief of the Bureau of Hygiene and Sanitation, New Jersey Department of Labor.

Next to the questions of wage, hour, and the substitution by the management of a spirit of coöperation for the military spirit of command, no factor contributes more to the reduction of the labor turnover than that of sanitary and hygienic working surroundings. Contrary to general belief, these need not be the monopoly of the newly built factory.

While the most recent standards of construction offer many advantages (especially along the line of natural ventilation and economic lighting), nevertheless, by means of mechanical exhaust systems, scientific illumination, and the installation of simple but adequate types of sanitary facilities, practically every handicap imposed by earlier structural defects may be overcome by the progressive employer.

Today there is no reason why the old-fashioned plant should not hope to hold as steady and efficient a force as its "model" competitor. Experience has shown that even the most costly alterations to improve the conditions of working premises eventually pay for themselves in increased efficiency of output, in the steadying of labor, in the reduction of time lost through illness and intemperance, and in a more uniform excellence of production. The employer who allows himself to be discouraged by apparent difficulties from furnishing the minimum hygienic requirements in his plant, must be prepared to compete at a disadvantage with those who (unlike himself) are getting a fair return in work for the wage they pay, from a non-shifting, contented, and physically fit working force.

The physical needs of the worker are no longer subject of speculation. We now know that the immemorial handicap to industrial efficiency is the fallacy that industry profits by gambling with the

limitations of the human body. The unregulated turnover (especially in the unskilled trades) has fostered our reliance on force, (which is measured by hours), rather than on strength, which should, be measured by years. In the skilled trades it has reconciled the American employer to a negative, rather than a positive, standard of health.

But the steady force in the regulated industry can only be made up of men capable of giving service six days out of seven. Moreover, they must give a uniform service that guarantees a steady, rather than a fluctuating, flow of production. And since the effect of the working environment upon the body of his employes is of incalculable importance to the employer, the standardization of hygienic essentials must be ranked by him with the questions of wage and hours, if the wastage of the turnover is to be satisfactorily eliminated from his plant.

GENERAL VENTILATION

Fresh air is the prime requisite for the conservation of physical efficiency. In an eight-hour day the worker breathes from 250 to 350 cubic feet, according to the vigor of his muscular exertion. How basic is the relation between vitality and the normal lung function, may be realized from the fact that respiration during the average workday represents an expenditure of energy expressed by the lifting of seven tons one foot. Whether, during those eight hours, there shall be a normal balance maintained between his expenditure of energy and the recuperative cell-building processes in his body, or a steady depletion of vitality and the accumulation in his system of the poisons of fatigue, depends largely upon the supply of oxygen in the air of the workroom. The body so poisoned is incapable of maintaining a 100 per cent efficiency of output, however desirous of good results its possessor may be. Above all, the body filled with poisons generated by the fatigue of lung-starvation craves a stimulant with increasing insistence at the end of each succeeding day.

Not only should air be reasonably pure, but in order to promote steadiness of output, it should never be allowed to stagnate, however ample the dimensions of the workroom. A lassitude that cannot be conquered, often characterizes departments where air space per capita is so far in excess of ordinary requirements, that systematic ventilation has been judged unnecessary. The forces of the

body may be said to act as secondary lungs; and scientific experiment has proved that these normal functions cannot be satisfactorily performed except under the constant stimulus of an air exchange that avoids extremes of temperature.

Unfortunately, for seven months of the year, reliance cannot be placed on direct ventilation from windows or skylights of the ordinary type. In every department a handful of men will be found who insist on working in an hermetically sealed room. One of the most costly handicaps of modern concrete or other tightly constructed factories is the fact that they are not practically self-ventilating in winter, as was the case with most of their rambling, loose-jointed and unsightly predecessors. The problems of maintaining adequate and draughtless air exchange, therefore, are of importance to the occupier of "model" premises, as well as to the employer in the old-type plant which has outgrown its quarters. And both must choose between the customary slow and costly decline of vitality on the part of their working force during half the year; or between a perpetual struggle to maintain so-called "natural ventilation" in their workrooms, in preference to the equable and reliable air-exchange guaranteed by a standardized mechanical exhaust system.

While an elaborate system of air conditioning may be essential in trade processes demanding absolute freedom from dust and uniform temperature; and while all heat-generating units should be provided with individual exhaust equipment that will remove the heat at its point of origin, the ordinary workroom does not require a costly ventilating installation, or one that calls for high expenditure of fan power for its operation.

The great essential is to maintain a satisfactory balance between the air drawn from the room, and the fresh air admitted to take its place. If the ingress openings be some three times the area of the egress openings; if they be uniformly distributed, and the air admitted be conveyed over warmed steam coils; the problem of a draughtless ventilation during the winter months should be solved to the satisfaction as well as the physical advantage of the workers. It must be borne in mind that the extreme of scientific air-conditioning is rarely popular among those in the shop; and, except in processes where the admission of outer dust or a radical change of temperature is fatal to the product, it is wiser to omit arbitrary pro-

hibition against an occasional opening of windows; even though the perfect operation of the exhaust system may be temporarily hampered thereby. The gradual education of the worker as to the benefits of clean air, and as to the best means of obtaining it in the factory during the cold season, is worth the expenditure of at least as much time on the part of the management, as that everywhere devoted to his education in the care and upkeep of equipment and tools.

In the case of heat-generating units, general ventilation affords no adequate relief to those directly exposed to radiation. A satisfactory type of hood consists of an inner and outer skin, with a free air space of several inches between the two; through which the air of the room is pulled at a velocity of several hundred feet per minute; thereby creating a layer of continually tempered and practically non-conducting air, between the hot inner hood and that next the workroom.

In certain incidental processes where the necessity for draughtless ventilation in limited areas makes mechanical ventilation unsatisfactory, it will be found that the adoption of muslin in lieu of glass in the lower panes of the ordinary window, gives relief from the dead air commonly endured. A medium grade muslin of light color is a better non-conductor of heat than glass. If it be renewed at intervals, it will not prevent a free exchange of air, or lessen the diffusion of light.

In the ventilation of foundries, (once one of the most difficult problems in industry), it has been proved that a type of construction either providing windows the entire length of the side walls of the building, with additional tiers in the roof monitor extending the full length of the structure, or a patented type of construction with an inverted roof-peak, movable side sash, and the standard window lighting area of 40 per cent of the floor space, insures satisfactory removal of smoke and gases; and provides (if vestibule entrances be insisted upon), a reasonably draughtless moulding floor.

It should be noted that the best results are obtained from pivoted monitor windows, (whatever be the industry), when they can be opened at full length; so that they may be changed from a vertical to a horizontal position. This swing through an arc of 90 degrees permits advantage to be taken of the direction of the prevailing wind; so that the strong air currents from the outside may create an upward draught by blowing over and through the monitor

itself, instead of down through the foundry or workroom, thereby counteracting the natural upward tendency of smoke, heat and gases.

DUST REMOVAL

The presence of animal, vegetable, metallic, or mineral dusts in the air of the workroom is a menace to the self-respect and vitality of the worker. When such dusts are, in addition, of a cutting or poisonous character, their hazard is increased a hundredfold.

When it is remembered that at each breath some sixty cubic inches of dust-laden air may be inhaled by a worker, the ultimate injury possible to the twenty square feet of surface of the 500,000,000 air cells of his lungs becomes apparent. In the case of buffers, grinders, and polishers, (before the days of mechanical exhaust protection), the tuberculosis mortality of the group exceeded 60 per cent, in contrast to the normal 14 per cent for the general registration area. Printers, subjected to lead dust and fume, show a consumption mortality in the neighborhood of 70 per cent. Almost as high are the records of potters exposed to flint dust, and of mill workers subjected to clouds of irritating wood dusts.

Aside, however, from questions of health, a dusty workroom inevitably lowers standards of shop discipline and output; induces chronic intemperance, (due to thirst engendered by congestion of the mucous membrane of the throat), and a general sense of physical malaise and depression; and commonly increases friction in personal relations with the foremen, among those whose normal recuperation from physical and nervous fatigue is made impossible by the unsanitary conditions of their working environment. While the direct financial loss involved in the waste of a majority of dusts and fumes in the workrooms is not of serious moment to the management, the indirect losses above noted justify the most rigid precautions for their control.

The secret of successful mechanical exhaust removal of dust and fume from working processes lies in its control at the point of origin. While this was once regarded as impractical in many industries, modern engineering experience has solved practically every working problem, whatever be the specific gravity of the dust or fume in question.

One of the greatest handicaps experienced by the manufacturer has been the vague character of the sanitary requirements in vogue

in different states. The terms "adequate" and "sufficient" have left him free to expend thousands of dollars on experiments, the results of which have too often given little of the protection to the health of the worker promised by irresponsible contractors. The defects in such installations result in most cases from too small trunk lines, thereby increasing skin friction; bad angles, inducing blocking of the pipes; overloaded fans; and poor construction materials.

The usual and inexpert practice in building a dust exhaust system, such as is required for buffing, polishing or grinding wheels, is to proportion the main suction pipe so that at all cross-sectional points it only equals the combined areas of the branch pipes entering the same; while the inlet of the exhauster used on such a system has an area that but equals the combined areas of all the branch pipes used on the system. For example, for twenty-five four-inch branch pipes the largest diameter of main pipe and exhauster would be twenty inches. A fifty-inch exhauster would have an inlet twenty inches in diameter; if it were necessary to get a suction-head at each branch pipe sufficiently strong to displace two inches of water in a pressure gauge (commonly called a U-shaped tube) it would require an actual velocity of 4,000 lineal feet per minute in the branches, and it would be necessary for the exhauster to handle 8,720 cubic feet of air. It would require approximately sixteen horse power to obtain these results.

This kind of a system should no longer be permitted. Standards based on actual working tests and experience prove that efficiency requires for twenty-five four-inch pipes a main pipe with, at all its cross-sectional points, an area 20 per cent larger than the combined areas of branch pipes entering the same. The inlet of the exhauster attached to the system must have an area 20 per cent larger than the combined areas of all branch connections on the system. For example, a system having twenty-five four-inch branch pipes would require an exhauster that has an inlet twenty-two inches in diameter; and the main pipe connected with this exhauster would taper, in accordance with the location of the branches, from the exhauster to the tail of the system. This kind of system would require a fifty-five-inch exhauster having a main pipe twenty-two inches in diameter; and to obtain a suction sufficient to displace two inches of water in a U-shaped tube, the air in each branch pipe would be obliged to have a velocity of 4,000 lineal feet per minute. The

exhauster would handle 8,720 cubic feet of air a minute; and the exhauster would take about twelve horse power to operate it.

While a distinct saving of 25 per cent in horse power is thus gained, this advantage, though important in itself, is greatly enhanced when it is understood that it is practically impossible to obtain a uniform suction in a system where the main duct and the exhauster inlet are based on areas equal to the combined areas of the branch connections.

The fact that a fifty-five-inch exhauster requires less horse power than a fifty-inch exhauster is due to the decreased friction in the twenty-two-inch main pipe, as compared with a twenty-inch main pipe, a decrease of strain which permits a lower speed and pressure. This saving in power should in itself be sufficient to decide the character of a blower installation. It has been demonstrated that blower systems built in accordance with the latter standards are more economical in point of operation, as well as more efficient in caring for dust.

Not only has general faulty construction delayed the achievement of satisfactory dust removal in a large range of industries, but employers have overlooked the fact that unless appropriate material be employed in blower systems, and every detail of construction aid the flow of air generated, desired results cannot be achieved, nor can they be maintained through a reasonable life of the system.

MATERIAL AND CONSTRUCTION DETAILS

All systems, except those handling acid fumes, should be made of galvanized sheet steel. For systems handling acid fumes the base material should be coated with an acid-resisting composition, or be made of tile or earthenware.

Table No. 1[1]

Diameter of Pipe	
8″ or less	No. 24
9″ to 16″	No. 22
17″ to 24″	No. 20
25″ to 30″	No. 18
31″ up	No. 16

[1] It should be noted that the metal used in Table No. 1 is of lighter weight in accordance with the diameter of the pipe than in Table No. 2. Heavy dusts, that rapidly wear out the resisting surface should be conveyed in accordance with the specifications of the latter.

Table No. 2[1]

Diameter of Pipe	
8″ or less	No. 22
9″ to 16″	No. 20
17″ to 24″	No. 18
25″ up	No. 16

All elbows should be two gauges heavier than the pipe to which they are attached.

Riveting. All straight seams should be riveted with tinned rivets placed on not more than three-inch centers.

All round seams should be riveted as follows:

Diameter of Pipe	
4″ to 8″	4 rivets
9″ to 12″	5 rivets
13″ to 18″	6 rivets
19″ to 24″	7 rivets
25″ and larger	9″ centers

Where straight seams are made by means of a "groove or lock seam" riveting will not be necessary.

Soldering. All seams should be soldered air tight and edges coated.

Laps. All piping, etc., should have at least a one-inch lap placed in the direction of the flow of air.

Elbows. All elbows should be made on a radius in the throat of not less than one and one-half times the diameter of the elbow. No internal crimped edges should be used.

Collars. All pipe collars should enter the main pipes at an angle of forty-five degrees, and should be riveted and soldered to the main pipe.

Blast Gate. Every branch pipe should be fitted with a malleable iron blast gate with a slide attached to the gate.

Telescope Slip Joints. All telescope slip joints should be made with a wire edge or band iron. Slip should be two guages heavier than the outside pipe, and provided with a fastener to hold same in position.

Fan Inlet Connection. At the point where the piping connects with the suction side of the exhaust fan, there should be a detachable sleeve.

Automatic Fire Dampers. Wherever piping passes through a wall or floor or from one building to another, an automatic fire damper should be placed in the wall with blade of damper pointed toward the line of suction, and should be so hung on a fusible link that in case of fire the damper will drop into position and close the pipe.

Dust Separators. All exhaust fans handling dust or waste material should discharge into a dust separator which will separate the dust or material from the air. While it is not practicable to specify any particular dust separator, it is necessary to warn against installing a separator of too small a proportion as the resistance on the fan not only greatly increases the amount of horse power required, but also reduces the suction that should be obtained.

Supports. Separators should be set in structural steel frames and all piping suspended or supported with iron braces. All piping should be braced and supported at least every ten feet.

While in special installations the nature of the dust handled and its specific gravity and quantity may require a greater or less velocity of air, the minimum standard pull required for the average factory process demands that sufficient suction head shall be maintained in each branch pipe within fifteen inches of the hood, to displace two inches of water in a U-shaped tube.[2]

Aside from variations in the type of hood, and the air velocity required, all mechanical exhaust installations should conform to the standard details enumerated above.

FUME REMOVAL

In the case of processes generating fume, such as pickling, metal dipping in acid or alkali solutions, metal plating, involving cyanide fumes, and a wide range of nitrating operations, a special type of wooden, or metal box-like duct may be satisfactorily employed. This should extend along and above the back of the trough, or tank, or row of crocks; and should incline out and up from its narrow base of seven inches, at an angle of 115 degrees above the rising fumes.

The essentials of construction require that:

I—The main duct should have a cross sectional area at least equal to one-half the combined areas of exhaust openings.

II—The bottom of the main duct should be seven inches wide, and that the front should incline at an angle of 115 degrees to the bottom.

III—The exhaust openings with an area equal to 25 per cent of the area of the liquid giving off the fumes should be located as near the point of origin of the fumes as the nature of the work will permit.

IV—A velocity of air of 1,000 lineal feet per minute should be generated in each exhaust opening.

V—If sheet metal is used in the construction of the duct, an acid resisting paint should be used to prevent corrosion.

VI—The exhaust fan shall be treated with acid resisting paint to prevent corrosion.

In the case of steam removal, or the removal of excess heat, such as exists in a wide range of laundry processes, a type of hood

[2]Pressure should be taken by pressing the tube attachment over a small opening through the pipe, commonly known as the static method. Tests should always be made with all branches open and unobstructed.

has been evolved which practically encloses the steam or heat-generating unit, and yet permits the operative to retain unobstructed facilities for working.

The presence of humidity in the general air of the workroom, (usually due to localized generation of steam), is now generally recognized as a serious health risk, which invariably lowers vitality and efficiency. It is cause for congratulation that the warm-air method of steam-removal, based on the general mechanical ventilation of the room, has been superseded by the infinitely more satisfactory local type of installation, that catches the emanations before they are diffused.

An individual mechanical exhaust hood of a cabinet type is necessary in a variety of fume-generating processes, such as lacquering and spraying operations. While the specific gravity, or extremely volatile character of the substances employed, may dictate the location of the opening to the exhaust pipe, and the velocity of air-pull required; yet provided that the hood be ample, with a liberal overhang, and that a sufficient quantity of air at a low velocity be moved from the general vicinity of the operative, the air of the workroom should not be contaminated, nor should the health of the worker himself be endangered.

The subtle menace to physical efficiency involved in the employment of some fifty trade poisons in our ordinary industries, demands an absolute and localized control of every variety of their fumes and dust, if the standards of production are to be maintained by a steady force.

LIGHTING

The relation of eye strain to efficiency and general health, is a factor in every branch of employment from the office to the foundry. Glare may be as great a handicap to satisfactory work as the twilight once permitted in the molten metal, and in a variety of other trades.

The standardization of illumination necessary for satisfactory results in a thousand divisions of industrial production, calls for expert knowledge; based not only on the physical limitations of vision, but also on the character of the work handled, and the amount of application involved.

While manufacturing operations such as foundry work, rough

machining, rough assembly and rough bench work, ordinarily require no more illumination intensity than 1.25 to 2.50 foot candles, measured by means of a horizontal reference plane thirty inches above the floor, and a portable photometer or illuminator; fine manufacturing operations, such as fine lathe work, pattern, and tool making, require from four to six foot candles. Whenever natural light falls below these standards, artificial lighting must be employed; and may be roughly reckoned, with a good overhead system, on the basis that one candle power (spherical) per square foot of floor area, will produce an illumination of about three foot candles.

Natural Lighting. The economy of utilizing daylight in manufacturing operations is obvious; but structural handicaps, or the direct glare of sunlight, may offset many of its seeming advantages.

The three essentials of: first, sufficiency; second, continuity; and third, diffusion can only be obtained by the most careful and scientific calculations.

In the case of daylight illumination they are dependent upon (a) adequate window area; (b) means of reducing the intensity of direct sunlight; (c) supplementary lighting equipment for especially dark days and toward the close of winter days; and (d) interior wall and ceiling colorings as light as is practicable, and of a dull finish.

While limits of space forbid technical discussion of standardized methods of artificial lighting, the absolute economy to the employer resulting from the elimination of defective work, and lost time due to unsatisfactory illumination, as well as a reduction of accidents, should encourage the universal adoption of the best methods now obtainable.

Two facts should be especially borne in mind by those handling workers in the finer manufacturing operations. First, that the unshaded spotlight is a direct injury to both eyesight and quality of product; and second, that although hygienic working conditions may be relied upon to improve automatically the health and efficiency of the worker, no lighting, however perfect, can correct congenital or acquired defects of vision. For this reason, a competent oculist should second the work of the illuminating engineer; if the full value of the latter's labors is to be reaped by the employer.

WASHING AND DRESSING FACILITIES

In the conservation of the health and self-respect of the worker, as well as the reduction of intemperance, of shop friction, and of the labor turnover, no factor deserves greater emphasis than proper washing, dressing, lunch-room and sanitary facilities.

The man who leaves the plant unwashed and in his working clothes, (often saturated with sweat), is 80 per cent more liable to respiratory disease during seven months of the year than the worker who has washed up, and changed to street clothing, in a properly heated dressing room. Moreover, whatever the season, the man who starts home under the influence of the stimulus of bodily comfort which follows a bath and change to dry clothes, is much less liable to the temptation that waits behind the swinging doors of the saloon.

It is a mistake to feel that the essentials of hygiene demand the most costly type of installation. While cleanliness and convenience must be insured, a very simple equipment will often serve to revolutionize the general morale of the plant. But if the practice of washing and changing is to become uniform among all employes, no undue loss of time should be involved for the worker, attributable to cramped quarters, and to an inadequate scale of provisions.

The following standardizations are based on tested minimum requirements now in successful operation, and are adapted for a wide range of industries, including those handling large forces and more than one shift.

Washing Facilities. Washing facilities should consist of lavatory basins fitted with waste pipes and two spigots conveying hot and cold water; or troughs of enamel or similar smooth impervious material, fitted with waste pipes, but without plugs; and for every two feet of through-length, two spigots, conveying hot and cold water. Where basins are provided, there should be at least one basin for every five employes; and where troughs are provided, at least two feet of trough length for every five employes.

Where large numbers must be accommodated, especially in trades involving heat and dust, where the worker should strip to the waist in order to wash more thoroughly, a satisfactory substitute for the hot and cold water spigots is a perforated pipe, conveying tempered water, installed above the middle of the trough at a height above the edge of the trough of from eighteen inches to twenty-four inches. Stoppers should be pulled, so that all washing is done in running water; and a trough length of two feet to every five workers is also necessary, as in the case of the spigot installation.

Showers. In plants where the workers are exposed to dust, dirt, the handling of poisonous materials, excessive physical exertion, heat or humidity, efficiency requires the additional provision of shower baths in the proportion of one to every fifteen employes so exposed. These showers should be screened, and should be provided with movable wooden floor gratings and runways. Even in warm weather the chill of cement flooring is both disagreeable and unhygienic; and is largely responsible for the present aversion of the worker to the use of the typical factory shower installation.

Standard Minimum Dressing Room Facilities. Each worker should be provided with a clean place in which to change from street clothes to working clothing. A pipe-rail equipped with clothes hangers, and fastened high enough from the floor so as to prevent the clothes from dragging, may be acceptable; excepting when the workers are:

(a) Engaged in handling poisonous materials

(b) Exposed to injurious dust or fumes

(c) Exposed to excessive heat, humidity, or fatigue from physical exertion

Dressing Room. In such cases clean, lighted, ventilated and, when necessary, heated dressing rooms should be provided; separate from the workroom, but connected therewith. When poisonous materials are handled which expose the person of the worker to contamination, lockers should be provided, divided by perpendicular partitions, of a double type having the following dimensions: sixty inches high by twenty-four inches wide by twelve inches deep.

Single Lockers. Workers exposed to heat, humidity and excessive physical exertion should be provided with single type lockers having the following dimensions: sixty inches high by twelve inches wide by fifteen inches deep.

Much discomfort, and highly unsanitary conditions, may characterize the dressing rooms filled with solid steel lockers. The ideal arrangement is to connect the batteries of lockers with a mechanical exhaust system, which pulls a gentle current of air through their perforated bottoms, and out through the openings at the top. In absence of such ventilating method, however, it is especially essential that metal lockers be provided with perforated bottoms, shelves, and tops; and with fluted or perforated metal doors. The wire-mesh locker, while sanitary, is commonly unpopular with the higher grade employe.

Lunch Rooms. While all workers exposed to dangerous dusts or fumes should be provided with a lunch room, or rooms separate for the sexes, and apart from contaminated workrooms, their value to the employer in the interest of efficiency and the lessening of intemperance, makes their installation desirable in every grade of industry. The cold luncheon eaten in the workroom, is a demoralizing relic of standards long abandoned in other phases of shop organization; and is an anachronism in a plant where the relation of physical fitness to production is recognized.

As in the case of washing facilities, a simple equipment is usually satisfactory; cleanliness, light, warmth and good air are the prime essentials. Gas stoves or

steam tables on which food brought from home may be heated, are always popular; and the furnishing of milk, coffee, tea, soup, or a stew and bread and butter at a nominal charge, is an ultimate economy to the employer.

A word of warning may not be out of place to those who desire to establish a regular cafeteria lunch-room service. Unless the articles of food offered for the relatively hearty meal be of unexceptionable quality, both in material and cooking, the temptation to hurried over-eating will be found a serious handicap to production toward the end of the day. Provided, however, that the food be selected for its nutritive value; that its preparation insures ready digestion; and above all, that an extra time allowance of fifteen minutes be granted when the noon recess is ordinarily of but half an hour's duration, satisfactory improvement in the general health of the force, and a reduction of time lost through illness and intemperance, may be looked for.

Toilet Facilities. These should consist of one siphon action toilet bowl for each twenty persons or fraction thereof. Toilets should be frequently cleaned, well lighted, comfortably heated, and adequately ventilated to the outer air by a window or windows, except in cases where mechanical ventilation is permitted; and in addition, toilets should be separate for the sexes, and provided with vestibule entrances. Urinals, when deemed necessary, should be provided on a basis of one urinal for each fifty persons using same. Urinals should be properly flushed, and so installed as to prevent noxious odors from arising.

The plumbing used for washing and toilet installations should be made in conformity with the local requirements of the city wherein the plant is located. And special emphasis should be laid on the necessity for installing such facilities either under the roof of the main plant, or in buildings connected therewith by means of covered and warmed passageways, so that the exposure of the worker to chill and inclement weather may be eliminated.

Drinking Water. Drinking water should be furnished by means of sanitary bubbling drinking fountains, provided with pipe coils so arranged that they can be ice cooled during the summer months. The fountains should be of a type that prevents contamination from use.

Experience in every variety of industry intensifies the conviction of the fallacy of the belief that employes will either abuse, or fail to take advantage of, the sanitary and hygienic equipments above noted. Shop discipline now demands the same education of the worker along physical lines, which every foreman has long recognized as essential in the case of the actual routine methods of production. For the management of the modern plant to accept failure as the logical result of efforts to improve the efficiency of the human factor, is to accept a handicap which their competitors will overcome; and is to admit an incompetence in the handling of men, which would not be tolerated in the handling of their mechanical equipment.